ASSOCIATION BETWEEN THE BRITISH STANDARDS INSTITUTE'S INCISOR CLASSIFICATION OF MALOCCLUSION AND ANGLE'S CLASSIFICATION OF MALOCCLUSION - AN ANALYTICAL STUDY

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CERTIFICATE

This is to certify that the dissertation entitled "Association between The British standards institute's Incisor classification of malocclusion and Angle's classification of malocclusion - An analytical study" done by **Dr.V.THAILAVATHY**., post graduate student (M.D.S), Orthodontics and dentofacial orthopedics (branch V), Tamil Nadu Govt. Dental College and Hospital, Chennai, submitted to the Tamil Nadu Dr.M.G.R.Medical University in partial fulfillment for the M.D.S. degree examination (March 2010) is a bonafide research work carried out by her under my supervision and guidance.

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DECLARATION

I, Dr.V.Thailavathy, do hereby declare that the dissertation titled **"**Association between The British standards institute's Incisor classification of malocclusion and Angle's classification of malocclusion.- An analytical study " was done in the Department of Orthodontics, Tamil Nadu Government Dental College & Hospital, Chennai 600 003. I have utilized the facilities provided in the Government Dental College for the study in partial fulfillment of the requirements for the degree of Master of Dental Surgery in the specialty of Orthodontics and Dentofacial Orthopedics (Branch V) during the course period 2007-2010 under the conceptualization and guidance of my dissertation guide, Professor Dr. M.C. Sainath, MDS.

I declare that no part of the dissertation will be utilized for gaining financial assistance for research or other promotions without obtaining prior permission from the Tamil Nadu Government Dental College & Hospital.

I also declare that no part of this work will be published either in the print or electronic media except with those who have been actively involved in this dissertation work and I firmly affirm that the right to preserve or publish this work rests solely with the prior permission of the Principal, Tamil Nadu Government Dental College & Hospital, Chennai 600 003, but with the vested right that I shall be cited as the author(s).

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CONTENT

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INTRODUCTION

Orthodontics is a specialty, admirably described as a “science of infinite variations”. This is nowhere more true than in facial form and variations in occlusion. Hence we needed a system of classification which would embrace this field of enormous variation.

Classification of malocclusion is the principal step in turning the disorganised clinical concepts into disciplined science of orthodontics. Primarily, classification aids in the diagnosis and treatment planning of malocclusions by orienting the clinician to the type and the magnitude of the problems and possible mechanical solutions to the problems. Classification also facilitates communication between specialists, and in this regard it is imperative that orthodontists all speak the ‘same language’.

Running behind the pages of history of orthodontics we find contributions from Bourdet(1757), Hunter(1771), Fox(1803), Delabarre(1819), Schange(1841), Harris(1850),Farrar(1888) and many others on classification of malocclusion. These various contributions however, remained dissociated and chaotic until Dr. Edward Angle began to systemise them. By far the most universally accepted

classification in use today is Edward Angle's method, which was developed a century ago.

Angle’s classification was based on the premise that the first permanent molars erupted into a constant position within the facial skeleton which could be used to assess the anteroposterior relationship of the arches. This critical reliance on first molar position is the major short coming of Angles classification. The dynamic nature of the molar position in mixed dentition, changing as the occlusion matures, makes a molar defined classification not justifiable for young patients. Problems are also experienced by orthodontist in categorising cases with the forward drift of molars. And this classification is not applicable if molars are missing. These inadequacies in this classification have resulted in this particular approach being superseded by other classifications

In 1964 Ballard and Wayman (1964) first described the Incisor classification. Angle’s terms are used and, in most cases, the classifications are concordant. This classification has enjoyed wide acceptance since its introduction and has superseded Angle’s classification in UK .Based on the works of Backland {1963}, it now forms the basis of British standard institute’s (1983) classification of

malocclusion. The incisor classification is simpler and more reliable than Angle's classification. Patients are generally more aware of incisor rather than buccal segment relationship; thus its correction is a central concern of much orthodontic treatment. Modern orthodontists are more concerned with the proper position of the incisors relative to the profile for aesthetics and stability concerns and are willing to adjust first molar position and even sacrifice teeth to better align the incisors (concepts Angle would never have accepted). Further, many of the problems associated with Angle's classification can be avoided if attention is focused on the incisor relationship.

The incisor classification is based upon the relationship between the lower incisor edges and the cingulum plateau of the upper central incisors. Modern orthodontist require a shift away from Angle's paradigm of achieving ideal occlusion ,to the more essentially focussed soft tissue paradigm to meet the aesthetic demands . Incisor display and its relation to lip also play a vital role in deciding the aesthetic outcome. Hence it becomes a necessity to classify, diagnose and treat a malocclusion based on the incisor relation.

No doubt the Angle's classification still is universally used for its simplicity. No debate on that ...but we are in cross roads where there is

no molar. And it is an enigma to the clinicians and epidemiologists to classify a malocclusion in such conditions. In these conditions we mostly go in for the next most simple, reliable, non-Angle system of classification- the British Incisor classification.

Thus the purpose of this study is to analyse the association between the British Incisor classification and the Angle's classification so as to keep in pace with the soft tissue paradigm and to classify a malocclusion in cases of missing molar. This study has also attempted to find the possible reasons for the association.

AIMS AND OBJECTIVES

Aims:

To analyse the association between The British standards institute's Incisor classification of malocclusion and The Angle's classification of malocclusion.

Objectives:

An attempt to study the adaptation of the classification to permanent dentition and applicability to orthodontic diagnosis and treatment planning.

REVIEW OF LITERATURE

John hunter in 18th century[4,6] was the first to describe what we today call as normal occlusion.**Samuel S. Fitch, MD**[6]**,** whose book entitled a *system of dental surgery* published in **1829**, is considered the first definitive work on dentistry in the United States, which devoted a significant amount of information to irregularities of the teeth. He was the first to classify malocclusion and gave four states of this kind of irregularity.

Jean Nicolas Marjolin[18] **(1832-1839)** of France differentiates malocclusion between obliqueness of teeth and anomalies of dental arch. He further differentiates anomalies of teeth as anterior, posterior and lateral type and one from rotation around the axis of teeth. .

George Carabelli (1842)[18]**,** Viennese professor, was probably the first to describe in any systematic way, the abnormal relationships of the upper and lower dental arches. The term edge-to-edge bite and overbite are actually derived from Carrabelle's system of classification. He based his classification on various positions of incisors and canines as: Mordex Normalis(Normal occlusion), Mordex Rectus (edge to edge),

Mordex apertus(open bite), Mordex Prosus(protruding teeth), Mordex Retrosus(retruding occlusion), Mordex Tortusus(zig-zag occlusion).

F.C. Kneisel (1836)[18] in his treatise '**Der Zahn der Schiefstand' divided** irregularities of teeth into partial malocclusion (Dental we would say today) and general malocclusion (basal). A .general distortion occurs: 1) when the upper teeth protrude outside; 2) when the upper teeth protrude beyond the lower; 3) when the teeth of both arches are perpendicular to each other. A partial distortion occurs: 1) when the individual teeth of both jaws are out of position; 2) when the individual teeth protrude forward or backward; 3) when the individual teeth are crooked"

Simeon H. Guilford (1889)[6], dean of the Philadelphia Dental College, was regarded as one of the finest practitioners of that period. At the request of the National Association of Dental Faculties, he wrote the first textbook for students, Orthodontia: 'Malposition of Human Teeth, Its Prevention and Remedy', published **in 1889**. In it he attempted to offer a classification of malocclusion (p. 142): There are two divisions - simple irregularities or the malposition of few teeth with no important facial disharmony and complex irregularities, that is, malposition of

many teeth having corresponding facial deformity. (These divisions contain eleven classes of malposition.)

Review of literature related to the methods of recording and measuring malocclusion can be broadly divided into two types: qualitative and quantitative methods. Many research workers have attempted to devise qualitative methods of recording malocclusion, mainly for epidemiologic studies. The earliest methods of recording malocclusion were qualitative**.**

QUALITATIVE METHODS OF CLASSIFYING MALOCCLUSION

Classification of Permanent dentition

Angle's [1]method of classifying malocclusion has been widely accepted and used since it was first published in **1899**. Angle's system had taken into account, only the anteroposterior deviations in the sagittal plane. Edward Angle published his "classification of malocclusion" **in 1899 in the periodical, Dental Cosmos[1].** He supplemented the information presented in this article in the publication **in 1900 of the sixth edition** of his book, 'Treatment of the teeth and fractures of the maxillae. **In 1907, in the seventh edition of his book,** Angle again revised his classification .The foremost difference in Angle's writings in

1900 and 1907 is the emphasis he placed on the importance of maxillary first permanent molar. Angle, in 1900, in the sixth edition of his book, made Class II, a full premolar width disto-occlusion and Class III, a full premolar width mesio-occlusion (resulting in a Class I range of 14 mm). In 1907, seventh edition of his book, Angle revised the definition of Class I from a full premolar width in either direction to one half of a cusp in either direction (reducing the range of Class I to 7 mm). This refinement brought more malocclusions into the Class II and III categories, but still allowed too large a range for Class I to be considered an "ideal" or treatment goal in a discipline aspiring to precision.

Simon (1932)[3, 16, 34] developed his gnathostatic system which related the dentition to the cranium in the three dimensions of space: - Frankfort horizontal plane, orbital plane, mid-sagittal plane. While this was advanced for his time, acceptance of his method was hampered by the complexity of the equipment and the high degree of precision required. This concept of three-dimensional orientation of the dentition to the cranium is the forerunner to modern day gnathology. The validity of Simon's classification was questioned by Sved who demonstrated minor errors in locating Frankfort horizontal plane which would have a

major effect on the orientation of the orbital plane and its relationship to teeth.

Stallard (1932), McCall (1944), Sclare (1945)[16] recorded malocclusion qualitatively, but these researchers did not define the malocclusion symptoms to be recorded, thus malocclusion symptoms were recorded in an all-or-none manner. Only a few malocclusion symptoms were selected arbitrarily as the items to be recorded.

Fisk in 1960[16] considered all three planes of space in recording malocclusion. Additional measurements including labiolingual spread, spacing, therapeutic extraction, postnatal defects, congenital defects, mutilation, congenital absence, supernumerary teeth were also considered.

Bjork, Krebs and Solow in 1964[16, 17] developed a method to record malocclusion with clearly defined items of the recorded symptoms. The registration of the malocclusion was divided into three parts:

a) Anomalies in the dentition: tooth anomalies, abnormal eruption and misalignment of individual teeth.

b) Occlusal anomalies: deviations in the positional relationship between the upper and the lower dental arches in the three planes.

c) Deviation in space conditions: spacing and crowding

This comprehensive system however was developed for epidemiological purpose with little emphasis upon treatment need. It was widely used in studies of the prevalence in malocclusion in various countries of the world

Introduced in **1964 by Ballard and Wayman**[11, 66], Incisor classification had been widely used. Based on the work of Backlund (1963) it now forms the basis of British standard institutes classification (1983).

In 1969 Profitt and Ackerman[3] formalised a modern approach of classification based on five descriptive characteristics and defined nine groups of malocclusions. Specifically, arch-length problems, with or without an influence on the profile, are recognized; the influence of the dentition on the profile is taken into account; all three planes of space, not just the sagittal plane, are taken into consideration; the differentiation between dental and skeletal problems is made at the appropriate level; and diagnosis is inherent in the classification. An

additional advantage is that the logical approach used in constructing the classification is similar to that employed for preparing computer programs.

Bezroukov and co-workers in 1979[16] presented the results of collaboration between the World Health Organisation (WHO) and the FDI and proposed the **WHO/FDI method** of recording occlusal traits. The primary objective of the index was to determine prevalence of malocclusion and dental irregularities as well as to estimate the treatment needs of a population, as a basis for the planning of orthodontic services. The indications for treatment were scored into four categories: treatment not necessary, doubtful, necessary and urgent. This addition to the FDI method undermines its objectivity and introduces a high degree of clinical judgement.

In 1981 Kinaan and Burke[16,37] proposed a method whereby five features were assessed namely; overjet, overbite, posterior crossbite, buccal segment crowding and incisal alignment. Each dental arch was divided into three segments, an incisal segment and two buccal segments. The segments rather than individual teeth were then assessed in terms of intra-arch alignment and inter-arch relationships. However, this method requires four registration instruments for direct intra-oral

assessment which makes it rather impractical for epidemiological purposes.

Malocclusion was **etiologically (Moyers)** [43] classified based on the tissue primarily involved, namely osseous, muscular, dental.

Ballard's[42] **discussed** the various skeletal relationships based on the axial inclination of the upper and lower incisors. This classification was based on the assumption that the inclination of incisors within each arch is normal**.** . It is used more accurately at the chair side.

Ballard's conversion[42] gives the normalization of upper and lower incisor inclination over their respective bases in order to visualize clearly the extent of skeletal discrepancy. Lateral cephalogram was used to accurately measure the inclinations

Skeletal classification (Houston et al., 1993)[31,42]classifies the malocclusion based on the jaw relations. It is usually a clinical assessment, often supported by lateral cephalometric radiographs.

Canine classification (Houston et al. 1993)[31] is based on anteroposterior positions of upper and lower canine.

In 1992 Morton Katz[34] recognised the inadequacies in angle's classification and used the most anterior premolars as the reference teeth rather than Angle's choice of the first molars.

Classification for primary dentition:

In **1950 Baume.L.J** [41], classified primary teeth based on the relationship of upper and lower primary second molar called as terminal plane relationship

Morton katz (1992)35 modified Angle's classification for classifying mixed and deciduous dentition. He stated that central axis of upper first deciduous molar should bisect embrasure between two lower deciduous molars in modified Class I.

QUANTITATIVE METHOD OF CLASSIFYING MALOCCLUSION:

An Index of Tooth Position

Massler and Frankel (1951)[16,40] made the initial attempt to develop a quantitative method of assessing malocclusion. In this "Index of Tooth Position", the total number of displaced or rotated teeth was the basis for the evaluation of prevalence and incidence of malocclusion in population groups. Assessment was based on individual teeth as units of occlusion rather than on arch segments. Tooth displacement, rotation, infra-occlusion and supra-occlusion were recorded. The number of maloccluded teeth was summed up to give an overall measure of malocclusion.

Unfortunately, this was not reliable because of the difficulty in judging the conformity of each tooth to an ideal position in all planes of space. Furthermore, because each tooth was recorded in an all or none manner - maloccluded or aligned, it gave no relative indication of severity **(Otuyemi and Jones, 1995)**.

The Dentofacial index

It was developed by **Elasser in the year 1953**[15, 16] primarily as an epidemiological tool. It measures the dentofacial morphology using facial landmarks and certain features of malocclusion. The facial orthometer was developed to facilitate this measurement. This index has been found to be of greater value for anthropological studies than for epidemiological research

The Malalignment Index

Van Kirk and Pennell (1959)[65] proposed the Malalignment Index (MI), which involved the grading of tooth displacement and rotation. This index examined the arches in isolation, with each arch divided into three segments. They quantitatively defined two malocclusion traits: tooth displacement and rotation, the scores of which were summed up to give a full-mouth index. This method of scoring did not reflect the true severity of the malocclusion because no account was taken of the relationship between the upper and lower teeth in occlusion (Otuyemi and Jones, 1995)

The Occlusal Feature Index

The Occlusal Feature Index (OFI) proposed **by Poulton and Aaronson in 1961**[47] was developed to measure malocclusion in population studies. The index was based on four primary features of occlusion considered to be of importance in orthodontic examination, namely, lower anterior crowding, cuspal interdigitation, overbite, and overjet. Scores were allocated for specific deviations from normal for each criterion and summed to give an overall index within the range 0-9, with zero denoting normal occlusion. Although this index was considered incomplete since only four features of occlusion were measured and scored (Tang and Wei, 1993), it has been found to have reasonable inter-examiner reliability and good correlation with treatment need (Otuyemi and Jones, 1995)

Handicapping Malocclusion Assessment Record

In 1968, Salzmann[57] developed the Handicapping Malocclusion Assessment Record (HMAR). The purpose of this was to provide a means for establishing priority for treatment of handicapping malocclusions. He defined handicapping malocclusion and handicapping dentofacial deformity as conditions that constitute a

hazard to the maintenance of oral health and interfere with the well-being of the patient by adversely affecting dentofacial aesthetics, mandibular function, or speech. However, the HMAR was found to have less precision and more bias when tested against the OI and the TPI (**Hermanson and Grewe, 1970; Grewe and Hagan, 1972).**

Index of Orthodontic Treatment Need

Brook and Shaw in 1989[11] formulated the Index of Orthodontic Treatment Priority. This was later named the Index of Orthodontic Treatment Need (IOTN). The IOTN has two discrete components, namely, a dental health component and an aesthetic component. The dental health component has five grades ranging from grade one, "no need" for treatment, to grade five, "very great need." A grade is allocated according to the severity of the worst single trait that describes the priority for treatment. The aesthetic component consists of a series of numbered photographs that are rated for attractiveness on a 10-point scale. The purpose of the IOTN was to rank malocclusion based on the significance of various occlusal traits for dental health and aesthetic impairment, with the intention of identifying those who would be most likely to benefit from orthodontic treatment (Otuyemi and Jones, 1995).

MODIFICATIONS OF ANGLE'S CLASSIFICATION:

Dewey (1915)[52,60] noted that because the first maxillary molar is just as liable as any other tooth to assume an abnormal position, classification should be based on the antero-posterior relation of the arches as a whole rather than only the first molars. He introduced three types of sub-classifications to Angle's Class I malocclusion; type 1: crowded maxillary anterior teeth; type 2: maxillary incisor in labioversion; type 3: maxillary incisor in linguoversion

Anderson later added two more **(Dewey and Anderson; 1935**[52,60]) type 4: molars or premolars in bucco or linguoversion; type 5: mesioversion of molars only

Recently **El-Mangoury and Mostafa (1990)**[14] added yet another two; type 6: diastemata; type: 7 deep anterior bite.

Lischer in 1933 further modified Angle's classification by giving substitute names for Angle's class I, class II class III malocclusion with terms neutrocclusion, distoocclusion and mesiocclusion. He also proposed terms to designate individual tooth malocclusion.

Henry (1957)[27] found variations existed within class II div I malocclusion and he suggested 4 types of class II div I. He also illustrated the use of lateral cephalogram as an adjunct to study models, case histories and patient examination in classification.

Jan De Baets and Martin Chiarini in 1995[8] defined a new type of malocclusion called pseudo-class I. Pseudo-Class I is an apparent Class I molar and canine relationship that has developed too mesially because of a combination of lower anterior crowding, mesial rotation of the upper first molars, and lack of space for the erupting lower canines.

To obtain best results in treatment of patients with Angles class III malocclusion **Je UK Park (2001) et al**[48] further classified this group into 3 types based on the abnormalities of maxilla.

Quantifying Angles classification:

Katz (1992)[34,35] proposed a classification method that retained the nomenclature of Angle, but changed it from a discrete system to that of a continuous, "ruler" measurement system by quantifying in millimetres the sagittal discrepancy of occlusion. Katz modified Angle's classification system to be more precise, narrowing the range of Class I

from 7 mm to a single point (that of ideal intermeshing). Any deviation from Class I was then measured to the nearest millimetre.

Like the Katz system, **Pair et al (2001)[46]** defined the grey area and limited Class I to a single point; but unlike the Katz system, which defined deviations away from ideal Class I in millimetres, they chose a more practical system that allowed visual measurement without the need of a ruler - defining a malocclusion to the nearest quarter cusp.

CRITICISM OF ANGLE'S CLASSIFICATION:

Authors criticising Angle's classification by developing their own system of classification:

Most notable are those of Dewey, 1915; Hellman(1921);Simon, 1932; Dewey and Anderson, 1935; Henry 1957; Ballard and Wayman, 1964; Ackerman and Proffit, 1969; El-Mangoury and Mostafa, 1990; and Katz, 1990, Elsasser(1978). In addition, several occlusal indices have been developed in lieu of "Angle" to prioritize the severity of orthodontic problems and to decide who is eligible for care or what fee should be paid:-**Salzmann JA 1968[57]-** Handicapping malocclusion assessment to establish treatment priority. ; Shah – indices for

orthodontic treatment needs and standards; Shaw-the development of index for orthodontic treatment priority

Criticism faced by Angle's classification without proposed alternatives:

Calvin Case (1963) slated the Angle's classification for its total disregard of the relationship of the teeth to the face.

Horowitz and Hixon (1966) argued that Angle's classification ignores the dentoalveolar and skeletal contributions to the malocclusion.

Other authors criticise its failure to recognise that malocclusion as a three-dimensional problem by only taking into account antero-posterior deviations in the sagittal plane **(Ackerman and Proffit[3], 1969; Isaacson et al., 1975; Rinchuse & Rinchuse, 1989[51]; Graber and Vanarsdall, 2000[23]).**

Graber and Swain[22] (2nd ed.) pointed out that Angle's classification fails to distinguish between malocclusions with analogous anteroposterior relationships, which require different treatment plans.

In 1989 Rinchuse and Rinchuse[51] found "Angle" limited because it is a system of discrete classes vis-a-vis a continuous system.

They further mentioned that Angle was not clear about the description and definition of his classes and his writings are equivocal, leading to the possibility of one class overlapping into another.

In addition, **Angle (himself)** admitted that his classification system does not address all possible malocclusion types, such as the case where one side is Class II and the other is Class III.

Last, **Ackermann[3], Graber (1972)[21], Rinchuse(1988)[51]** challenged the validity of Angle because it only addresses the sagittal dental dimension and does not address the vertical and transverse dental dimensions; it also lacks a consideration of the face.

Criticisms on reliability of Angle's classification:

Several other investigators, in addition to Katz, have provided data showing the lack of diagnostic reliability in Angle's system.

Brash et al (1956) believed that studies reporting the range of occurrence of normal occlusion from 8.6% to 77.6% in reality reflect differences in the application of Angle's Classification system rather than differences between communities.

Gravely and Johnson (1974)[20] demonstrated poor interexaminer and intraexaminer reliability for Angle's classification.

Baumrind et al (1996)[9] reported disagreement among clinicians who used Angle's classification for 22% of adolescents and 26% of adults. The range of this disagreement was such that 1 patient was diagnosed as Class I by 2 clinicians, having a Class II tendency by a third, as Class II subdivision by a fourth, and as Class III unilateral right by a fifth.

Ast et al (1964)[7] reported that 2 orthodontists disagreed on the classification of 30% of 302 sets of study models independently classified according to Angle's system.

In 1998 Du SQ, Rinchuse DJ, Zullo TG, Rinchuse DJ[52] assessed the reliability of three methods of classification – Angle's, Katz, and Incisor and found that Angle's classification was the least reliable of the three method . The Katz classification had the highest reliability and the British standards incisor classification was next highest. The inconsistencies with Angle and the British system were partly explained by the fact that they rely on discrete categories, whereas Katz rely on continuous variable.

Pair et al (2001)[46] conducted a study that showed that, when one uses more specific criteria, such as defining a malocclusion to the nearest quarter cusp, there was high diagnostic reliability between practitioners.

Randall Snydera in 2007 [60] also concluded from the results of his survey that orthodontic educators are more comfortable with a more descriptive way of classifying patients than Angle who provided his revolutionary system a century ago.

In 2000, Brin I, Weinberger T, Ben-Chorin E[10] made an attempt to introduce a 'combined' system comprising Katz's modification and overjet/overbite millimetric measurements in order to attain a more meaningful and complete classification of malocclusion than is presently available. It is concluded that in view of the relatively low agreement in the 'combined' method, it cannot be recommended for clinical application. The Katz's modified method, on the other hand, may be a helpful supplement to Angle's classification.

INCISOR CLASSIFICATION:

In 1964 Ballard and Wayman[31] first described the Incisor classification, Angle's terms are used and, in most cases, the

classifications are concordant. This classification has enjoyed wide acceptance since its introduction and has superseded Angle's classification in UK .Based on the works of Backland {1963}, it now forms the basis of British standard institute's (1983) classification of malocclusion.

Donald J.Rinchuse & Daniel J.Rinchuse(1998)[52]analysed the reliability of three methods of classification systems and stated that British Incisor relation is more reliable than Angle's classification. But less reliable than Katz classification

In 1992 William and Stephen found[66] that the incisor classification had a wide range of disagreement between the examiners and modified the British standard incisor classification by extending it to include a class II intermediate group.

Ize-Iyamu I.N, Umweni A.A (2006) [32] used incisor classification to assess the malocclusion in pre-schoolchildren in Benin City. They stated that incisor classification is a simple and reliable means of evaluating malocclusion when molars are not in place. It is also used to evaluate the need for early management.

MATERIALS AND METHODS

Study design:

This is an analytical, observational, cross-sectional study, documenting the association between the Angle's and British incisor classification.

Sampling:

Two hundred study cast were randomly selected from the patient's records at the department of orthodontics,TNGDC&H. No duplicate of dental casts were selected and there was no consideration given for chronologic age, sex. Only pre-treatment cast displaying full permanent dentition (with the exception of third molars) were selected. Selected samples were generally typical and posed no difficulties in classifying malocclusion based on Angle's or British Incisor classification.

Samples were divided into 4 groups based on British standard institute Incisor classification –class I, class II div I, class II div II, and class III. Class I group consisted of 84 samples; class II div I consisted of 72 samples, class II div II consisted of 23 samples and class III group consisted of 21 samples.

Frequency distribution of the samples is depicted as pie chart in chart no: 1

Each model in all four groups was also classified based on Angle's classification and were tabulated.

Selection criteria:

- Stable centric occlusion using squash bite
- No voids or blebs in the orthodontic study models
- No fractures on the teeth on the study models
- No previous orthodontic treatment taken

Exclusion criterion:

1. Mixed or deciduous dentition
2. Missing molar
3. Cleft palate cases
4. Open bite
5. Posterior cross bite
6. Premolar impaction
7. Missing incisors
8. Casts with restorations altering occlusal morphology

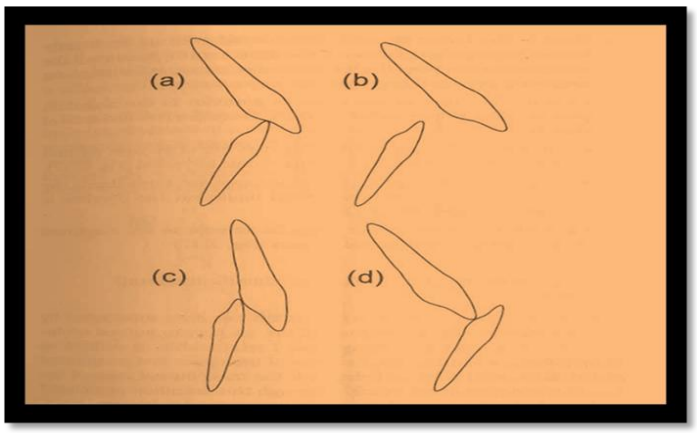
METHODOLOGY:

Study model preparation:

Study models are routinely prepared in our department by the following method. Impressions were recorded with alginate. Impressions poured with Orthocal and centric occlusion recorded with a squash bite. Symmetric bases were formed with type II plaster using rubber base molds (HP).They were well finished and polished, and stored in model boxes. Study models selected as samples, accurately reproduced anatomic portions and pleasing artistic portion, reproducing the centric occlusion accurately.

All the samples were randomly selected and the recordings were done by the same operator.

Samples were divided into four groups based on the incisor relationship as described by the British Standard Institute (1983);



- **a).Class I** - the lower incisal edges occlude with or lie immediately below the cingulum plateau of the upper incisors.

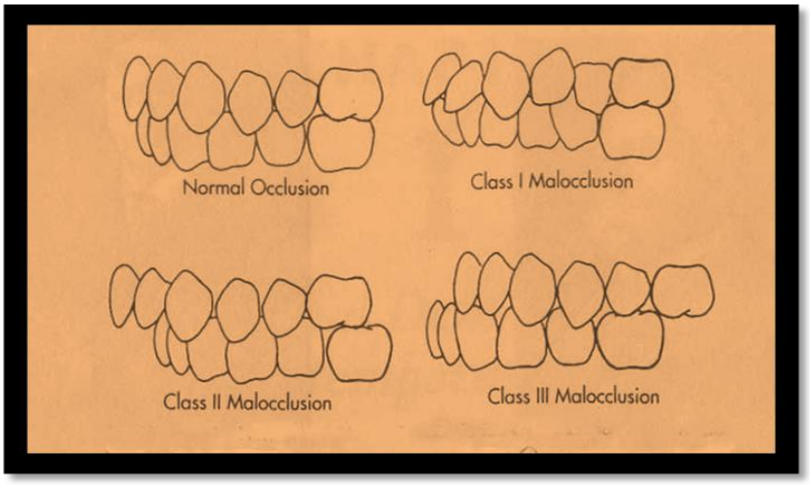
- **Class II** - the lower incisor edges lie posterior to the cingulum plateau of the upper central incisors.

  b).Division 1 - the overjet is increased and the upper central incisors are proclined.

  c).Division 2 - the overjet is minimal or increased with retroclined upper central incisors.

- **d).Class III** - the lower incisor edges lay anterior to the cingulum plateau of the upper central incisors. The overjet is reduced or reversed.

The models were again classified based on Angle's classification as described below: The upper first molar mesiobuccal cusp width of each subject was measured and was regarded as one cusp width



- **Class I:**

  Molar Class I was defined as occurring where the mesiobuccal cusp of the upper first molar occluded with the mesiobuccal groove of the lower first molar within the range of less than half a cusp width anteriorly or posteriorly.

- **Class II:**

  Molar Class II was defined as occurring where the mesiobuccal cusp of the upper first molar occluded anterior to the Class I position.

  Div I: characterised by proclined upper incisor and increased overjet.

  Div II: characterised by retroclined upper incisor and reduced overjet

- **Class III**:

Molar Class III was defined as occurring where the mesiobuccal cusp of the upper first molar occluded posterior to the Class I position

Subdivisions in Angle's classification was not taken into consideration

Stastistical analysis:

All data were recorded in Microsoft excel 2007 spread sheet and analysed using SPSS version 11.5.The overall association between British standards institute Incisor classification and Angle's classification, and association between each group of Incisor classification and the Angle's classification were assessed using chi-squares test. P value less than 0.05 were taken as statistically significant.

CHART NO: 1

PIE CHART: Frequency distribution of the samples based on British Incisor classification

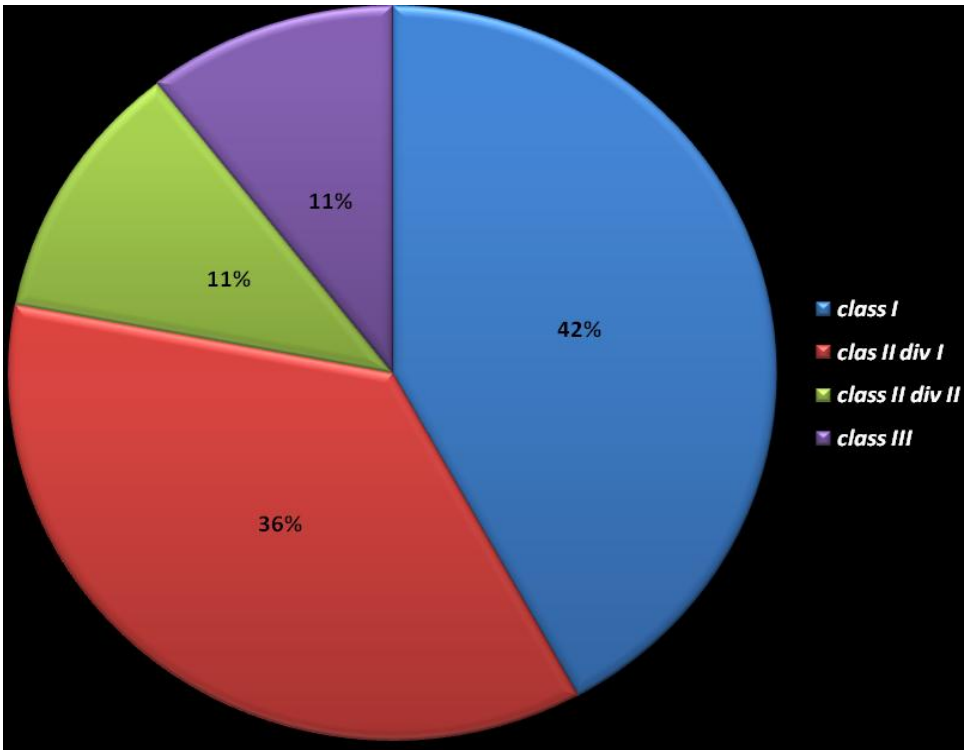


PHOTO PLATE NO:1

Class I British Incisor relation

Class I Angle's Molar relation

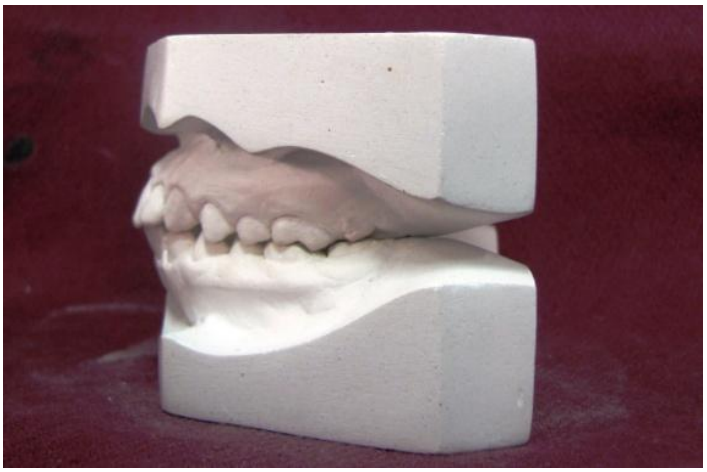


PHOTO PLATE NO:2

Class II div I British Incisor relation

Class I Angle's molar relation

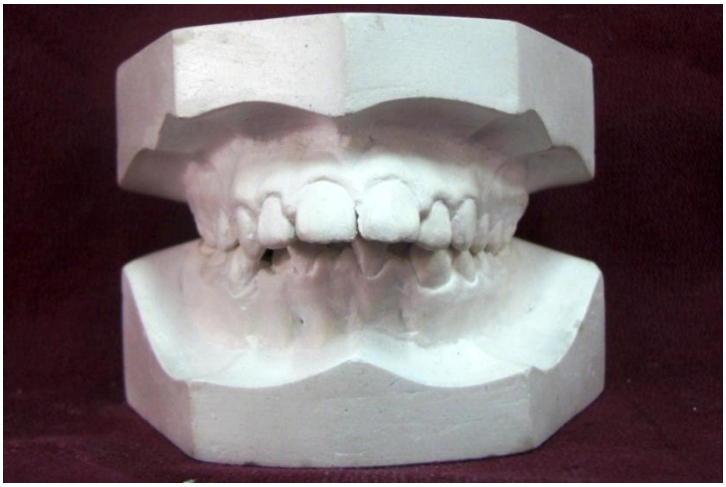


PHOTO PLATE NO:3

Class II div I Incisor relation

Class II div I Angle's Molar relation

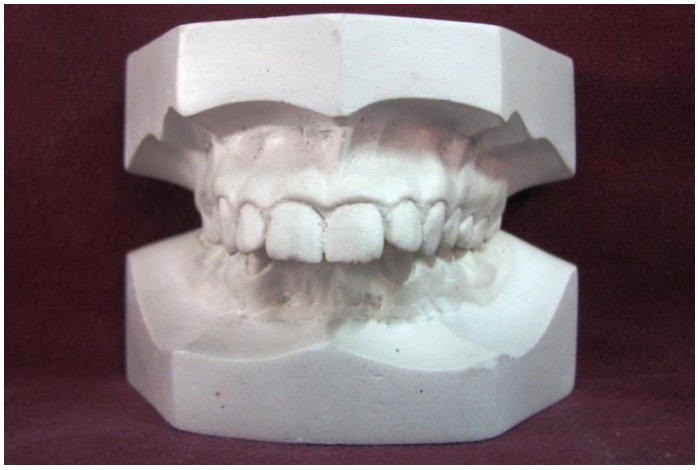


PHOTO PLATE NO:4

Class II div II incisors classification

Class I Angle's molar classification

PHOTO PLATE NO:5

Class II div II incisor relation;

Class II div II Angle's molar relation

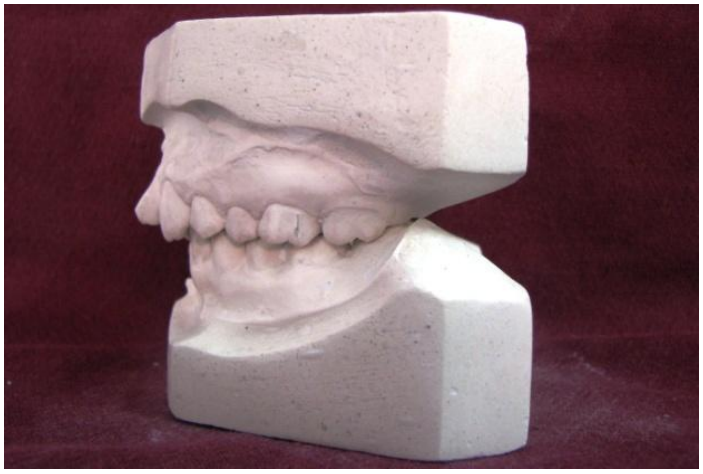


PHOTO PLTE NO:6

Class III incisor relation;

Class III Angle's molar relation

PHOTO PLATE NO:7

Class III incisor relation;

Class I Angle's molar RELATION

RESULTS

Two hundred samples were grouped into 4 groups based on British incisor classification and all the samples in each group were again classified by Angle's classification. The results were tabulated and overall association between British and Angle's classification and, Association between British and Angle's classification in each group (class I, class II div I class II div II, class III) was analysed using chi-square test. **p** value less than 0.05 is taken as statistically significant .

Table no: 1- Overall association between British Incisor classification And Angle's classification of malocclusion

		ANGLE				
		Class I	**Class II div I**	**Class II div II**	**Class III**	**Row total**
BRITISH	**Class I**	80	4			**84**
	Class II	29	43			**72**
	Class II div II	11		12		**23**
	Class III	3			18	**21**
	Coloumn total	123	47	12	18	**200**

(p=0.00)

Overall Association between British Incisor and Angle's classification were found using Chi-square test (table no: 1). p value was found to be 0.00 (which is less than 0.05). Hence there is statistically significant association between the two classifications.

Table no: 2-Association between British incisor Class I and Angle's class I malocclusion:

	Angle		
	Class I	**Class II div I**	**Row total**
British Class I	80(95.2%)	4(4.8%)	84(100%)

(p=0.00)

95.2% of British class I malocclusion belonged to Angle's class I and 4.8% belonged to Angle's class II div I. Chi-square test was done (table no : 2) and p value was found to be 0.00(which is less than 0.05). Hence a statistically significant association existed between British class I and Angle's class I.

Table no: 3-Association between British class II div I and Angle's class II div I malocclusion

	Angle		
	Class I	**Class II div I**	**Row total**
British Class II div I	29(40.3%)	43(59.7%)	72(100%)

(p=0.0990)

40.3% of British class II div I malocclusion belonged to Angle's class I while remaining 59.7% belonged to Angle's class II div I. Chi-square test was done to find the association between Angle's and British type of classification(table no: 3). p value was found to be 0.0990 (which is greater than 0.005). Hence, **no** statistically significant association existed between the two classifications in class II div I group

Table no: 4 Association between British class II div II malocclusion angles class II div II:

	Angle		
	Class I	**Class II div II**	**Row total**
British Class II div II	11(47.8)	12(52.2%)	23(100%)

(p=0.8348)

47.8% of British class II div II malocclusion belonged to Angle's class I while remaining 52.2% belonged to Angle's class II div II. Chi-square test was done to find the association between Angle's and British type of classification (table no: 4). **p** value was found to be 0.8348(which is greater than 0.05). It was found that **no** statistically significant association existed between the two classifications.

Table no: 4 -Association between British class III and Angle's class III malocclusion

	Angle		
	Class I	**Class III**	**Row total**
British Class III	3(14.3%)	18(85.7%)	21(100%)

(p=0.011)

Thus 14.3% of British class III malocclusion belonged to Angle's class I while remaining 85.7% belonged to Angle's class III. Chi-square test was done to find the association between Angle and British type of classification (table no: 4). p value was found to be 0.011 (which is less than 0.05).It was found that a statistically significant association existed between the two classification in class III group.

CHART NO: 2

Bar chart: 84 samples of British class I group consisted of 80 Angle's class I and 4 Angle's class II div I

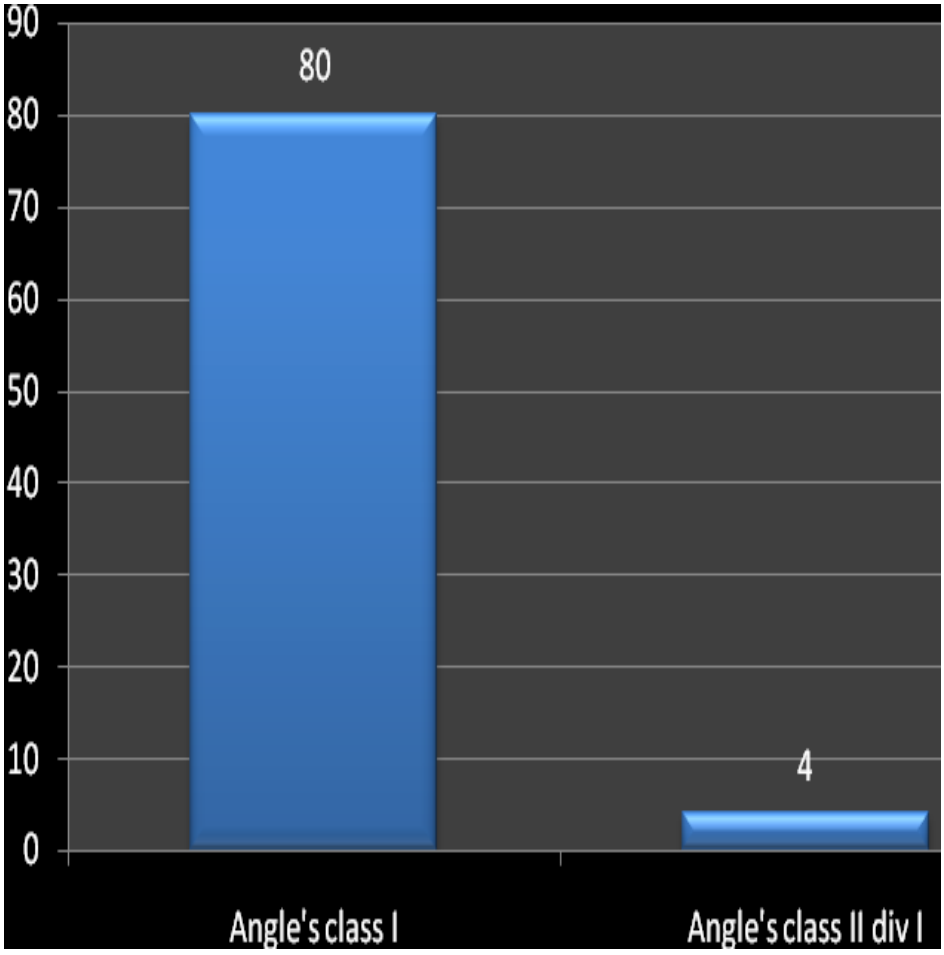


CHART NO: 3

Bar chart: 72 samples of British class II div I group consisted of 29Angle's class I and 43 Angle's class II div I

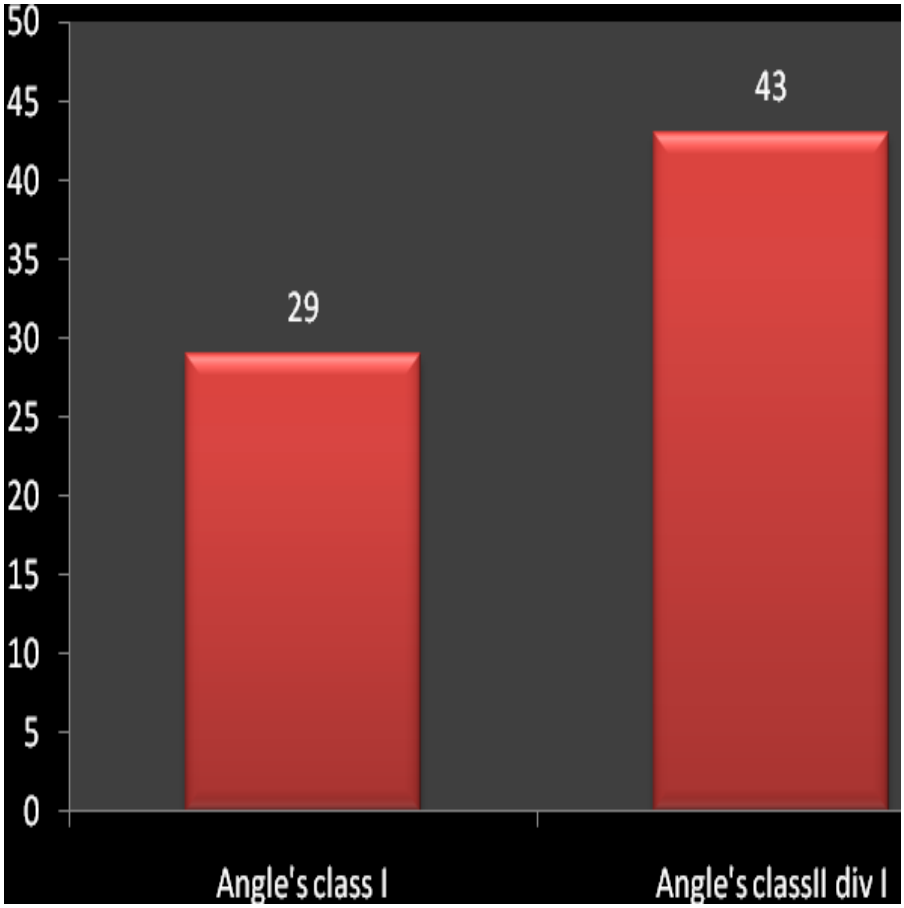


CHART NO: 4

Bar chart: 23 samples of British incisor class II div II group consisted of 11 Angle's class I and 12 Angle's class II div II

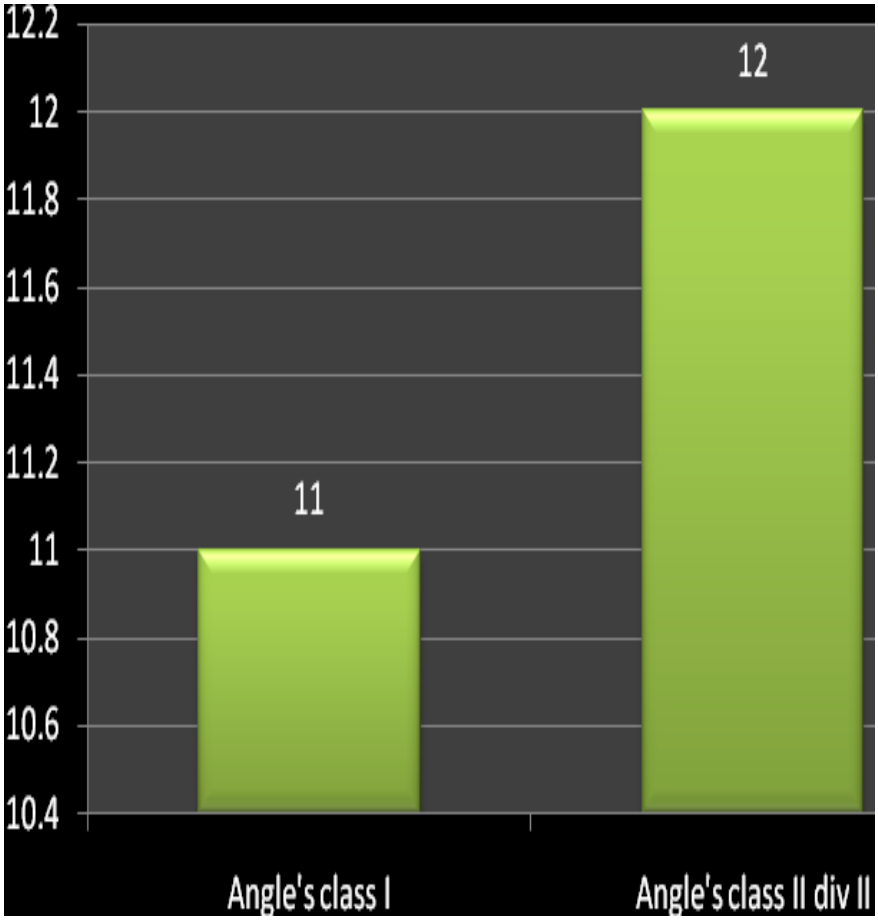
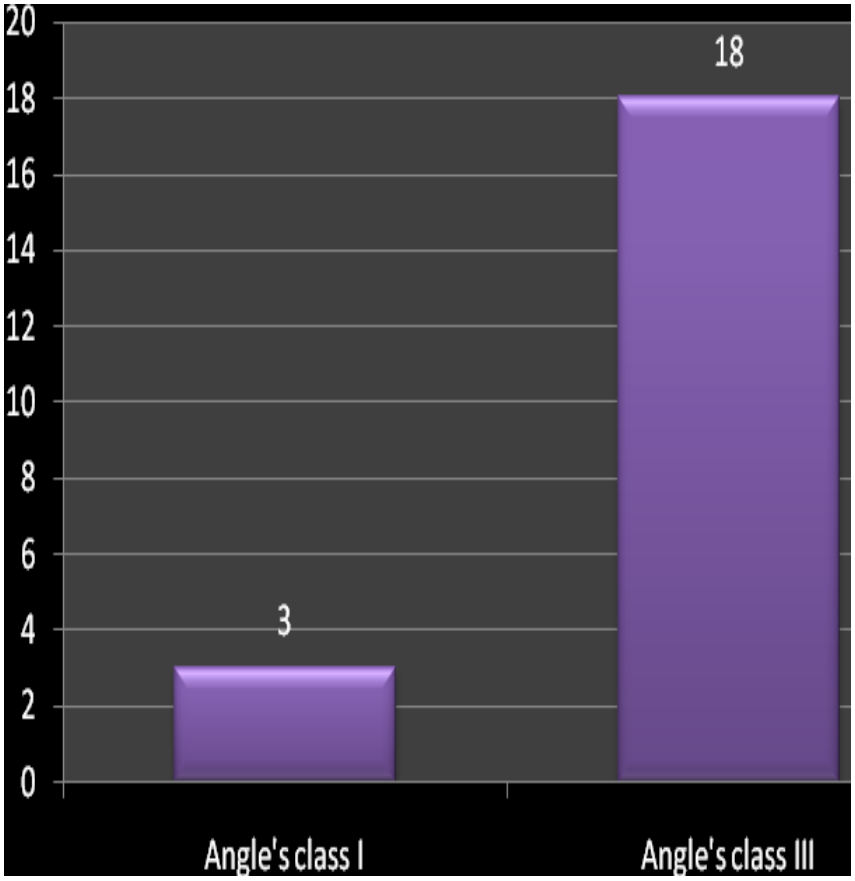


CHART NO: 5

Bar chart: 21 samples of British class III group consisted of 3 Angle's class I and 18 Angle's class III



DISCUSSION

Classification in orthodontics is concerned with the recognition of deviation from a quantitative and qualitative biological norm. It is defined as orderly reduction of data base to a list of the patient's problem.

Normality is the basis of classification in orthodontics. Malocclusion is any perversion of normal occlusion of the teeth. It is a condition where there is departure from normal relation of the teeth to other teeth in the same arch or to the teeth in the opposing arch. Diagnosis in orthodontics is based primarily on the classification of deviation from normal.

In order to acquire a better understanding of the many deviations from normal occlusion and to assist in diagnosis and treatment planning, it becomes necessary to group the varieties of malocclusion into order. This is difficult as occlusal anomalies are many and varied.

Need for classification of malocclusion:

In the specialty of orthodontics, the classification of malocclusion plays several important roles. **Morton Katz (1992)**[34] points out that classification aids in the **diagnosis and treatment planning** of malocclusions by orienting the clinician to the type and the magnitude of the problems and possible mechanical solutions to the problems. For example, a malocclusion classified as "Class II" would call for Class II mechanics.

Classification is an **essential communication tool** between dental school professor and student, between practitioners, and between practitioner and insurance company or government bureaucracy. It is essential that everyone "speak the same language." Consistency is especially vital in dental education, where the orthodontic student needs a uniformly applied congruent occlusion model, and clearly defined parameters that can be applied towards classifying a malocclusion.

Ease of reference is yet another reason for classifying a malocclusion. It is much simpler to call a case a class III malocclusion, than to go into all the details necessary to describe the craniofacial morphology of mandibular prognathism.

Moyers[43] stated that the categorisation of a malocclusion by its salient features is helpful for **describing and documenting** a patient's occlusion. In addition, classifications and indices allow the prevalence of a malocclusion within a population to be **recorded,** and also aid in assessment of need, difficulty, and success of orthodontic treatment.

Experience with previous case bearing the same label, facilitates the understanding of problems that may be encountered in treatment, thus, classification **aid in comparison**. There also are **reflexive or self-communicative** reasons for classification. When we name a malocclusion a severe class II, 1.we are identifying the problems of which, we must be wary, 2. recalling past difficulties with similar cases and 3.alerting ourselves to possible strategies and appliances that may be needed for the treatment.

Methods of classifying malocclusion (1993)[16]:

A good method of recording or measuring malocclusion is important for documentation of the prevalence and severity of malocclusion in population groups. This kind of data is not only important for the epidemiologist, but also for those who plan for the provision of orthodontic treatment in a community or for the training of

orthodontic specialists. If the method is universally accepted and applied, data collected from different population groups can be compared**.**

The methods of recording and measuring malocclusion can be broadly divided into two types: qualitative and quantitative.

Qualitative assessment of malocclusion:

Essentially, a qualitative assessment is descriptive and therefore this category includes the diagnostic classifications of malocclusion. The main drawback to a qualitative approach is that the malocclusion is a continuous variable so that a clear cut-off point between different categories does not always exist. This can lead to problems when classifying borderline malocclusions. In addition, although a qualitative assessment is a helpful shorthand method of describing the salient features of malocclusion, it does not provide any indication of the difficulty of treatment.

Qualitative evaluation of malocclusion was attempted historically before quantitative analysis. One of the better known classifications was devised by **Angle in 1899**[1], but others are now widely used, for example

the British standards institute (1983)[31] classification of incisor relationship.

Quantitative assessment of malocclusion:

In quantitative approach two different approaches can be used:

1. Each feature of a malocclusion is given a score and the summed total is then recorded (**e.g. PAR index Richmond et al 1992**[53].)

2. The worst feature of a malocclusion is recorded (e.g. **the index of orthodontic treatment need, 1981**[11])

VARIOUS SYSTEMS OF CLASSIFICATION:

Many orthodontists have developed classification methods, and among them are Angle, Bennett, Simon, Ackerman and Proffit, Ballard and Wayman, Lischer, Dewey, Anderson. However, by far the most universally accepted classification in use today is Edward Angle's method, which was developed a century ago.

Simon (1932)[16, 3, 34] developed his gnathostatic system which related the dentition to the cranium in the three dimensions of space. While this was advanced for his time, acceptance of his method was hampered by the complexity of the equipment and the high degree of

precision required. This concept of three-dimensional orientation of the dentition to the cranium is the forerunner to modern day gnathology.

In addition to describing malocclusion in three planes of space, **Ackerman and Proffit (1969)[3]** gave a Venn diagram which offers a visual demonstration of interaction or overlap among parts of complex structures. He included occlusal alignment, profile and soft tissue in his classification scheme.

British Incisor Classification System was introduced by Ballard and Wayman (1964) in the same premises of Angle's classification. The reliability of this system was considered superior to Angle's classification because the posterior teeth do not influence and conflict with the incisor occlusion type (Du *et al*., 1998).

ANGLE'S CLASSIFICATION OF MALOCCLUSION:

The development of classification of malocclusion in 1899 was an important step in the development of orthodontics because it not only subdivided major types of malocclusion but also included the first clear and simple definition of normal occlusion in the natural dentition.

Edward Angle published his "**classification of malocclusion" in 1899**[1] in the periodical, Dental cosmos. He supplemented the information presented in this article, in the publication in 1900 of the sixth edition of his book, "treatment of malocclusion of the teeth and fractures of the maxilla". However there are some obvious differences in the information presented in these two publications and the information contained in the 1907, seventh edition of his book, "Treatment of malocclusion of the teeth".

The fore most difference between Angle's writings in 1900 and 1907 is the emphasis he placed on the importance of the maxillary permanent first molars .In 1900 he considered maxillary first permanent molars and maxillary permanent canines as important teeth to judge the mesio-distal interarch relationship of the dental arches , but he believed all the teeth were to be taken into consideration when

determining the classification of cases .In 1907 Angle considered maxillary first permanent molar as reference teeth for determining classification, almost to the exclusion of other teeth.

In 1900, Angle defined Class I as a range, Class II as a full premolar width distoclusion, and Class III as a full premolar width mesioclusion. This resulted in a Class I range of 14 mm. Angle realized that this range was too large, and in 1907 he revised his definition of Class I from a full premolar width in either direction to one-half cusp in either direction (reducing the range of Class I to 7 mm). This refinement brought more occlusions into the Class II and Class III categories, but it still allowed too much range for Class I to be considered an ideal treatment goal.

Basis of angles classification:

Normal occlusion;

Angle's postulate was that the upper molars were the key to occlusion and that the upper and lower molar should be related so that the mesiobuccal cusp of the upper molar occlude in the buccal groove of the lower molar. If the teeth were arranged on a smoothly curving line of occlusion, and this molar relationship existed, then normal occlusion

would result. Angle also defined line of occlusion as a smooth curve passing through the central fossa of each upper molar and across the cingulum of the upper canine and incisor teeth .the same line runs along the buccal cusps and the incisal edges of the lower teeth

Angle's emphasis on molars:

Angle in his article entitled 'Upper molar as a basis of diagnosis in orthodontics' espoused the virtues of the maxillary first molars. He believed that all teeth are essential, yet in function and influence, some were of greater importance than others, the most important of all being the first permanent molars, especially the upper first molars, which were called the keys to occlusion;

a) They are the biggest teeth and their anchorage is strongest.

b) Their local position in the occlusal arch supports the main masticatory duty and operation.

c) They influence the vertical distance of upper and lower jaws, the occlusal height and aesthetic proportions.

d) The permanent molars are the first to erupt among the permanent dentition. The position of other teeth that erupt

later in the dentition is under the mighty control of first erupted molars

e) The anomalies in dental positioning are mostly due to a more prominently dislocated position of the crowns of upper permanent molars, and to a lesser extent due to a dislocation of their apex. These findings led Angle to postulate, that "the first upper permanent molar, more than any other tooth or anatomical point gives a precise scientific basis for defining occlusal disharmony and occlusal anomalies

Criticism faced by Angle's classification of malocclusion;

Morton katz[34] (1992)stated that Angle considered the upper first molar as the most reliable point of reference from which to compare other teeth because of its constancy in taking a correct position relative to the bony skeleton's jugal buttress (also known as the key ridge). Contemporary orthodontists, however, do not consider the anatomic interrelationship of the upper molar to the cranium as significant.

Angle acknowledged that the first molar might erupt in an altered position when influenced by the malpositions of other teeth or the loss or no development of deciduous and permanent teeth anterior to the first

molar. Therefore Angle recommended visualizing the upper first molar into its proper position relative to the jugal buttress before classifying the malocclusion. The problem with this concept is, visualizing the "correct" position of the upper first molar to the jugal buttress and lining up the remaining dental units relative to it is a very subjective pursuit. It is quite probable that no two orthodontists would exactly visualize the same "correct" position.

In addition, **Friel and later Arya** et al. demonstrated **the dynamic nature of the position of the first molar in the mixed dentition,** changing as the occlusion matures into the permanent dentition because of jaw growth and second deciduous molar leeway space considerations. This natural "adjustment" makes a molar-defined classification not applicable in young patients.

Rinchuse and rinchuse[52] (1998), Morton Katz[35] (1992) and Pair[46] (2001) criticised Angle's classification for its **lack of a numerical quantification** of the degree of Class II or Class III. Thus the Angle's classification is a system of discrete classes measuring a continuous variable

Cephalometric radiography has shown that the relation of the dental arches and teeth does not necessarily reflect the relation of the basal areas of the jaws and it has become customary to use the classification of Angle only to indicate the relation of the arches or tooth crowns and not the jaw relations as originally intended by Angle. **Skeletal and dental malocclusions are not differentiated from each other**.

Calvin case pointed out that Angle's method **disregarded (in treatment planning as well as classification) the relationship of the teeth to the face** (that is, profile).

Another criticism of Calvin case and others was that although malocclusion was three dimensional problems, in the Angle's system, **only anteroposterior deviations were taken into consideration**. The classification does not give an idea of vertical and transverse plane malpositions. Also **individual tooth malpositions cannot be visualised**.

The situation arising where one side of dentition is in a class III relation and the other side is in class II is beyond the parameters of Angle's classification.

Angle believed that facial harmony and balance were only possible with a full complement of teeth in ‘normal occlusion”. Thus Angle’s philosophy was opposed to the extraction of permanent teeth. Since Angle and his followers did not recognise any need for the extraction of teeth, **the Angle’s system did not take into account the possibility of arch-length problems**. The reintroduction of extraction into orthodontic therapy has made it necessary for orthodontist to add arch length discrepancy as additional step in classification.

Another criticism of the Angle’s system was that **it merely described the relationship of teeth and did not include a diagnosis. Hellman and Simon Lundstorm, most recently Horowitz and Hixon recognised** the need to differentiate dentoalveolar and skeletal discrepancy and to evaluate their relative contributions towards the creation of malocclusion.

Another criticism of the Angle’s system is **this classification cannot be applied to deciduous dentition.**

The severity of malocclusion cannot be judged from the classification of malocclusion and it does not differentiate between the true and pseudo class III malocclusion.

Ackerman and Proffit [3] (1969) pointed out that Malocclusion having the same Angle's classification may indeed be only analogous malocclusion (having only the same occlusal relationships) and not necessarily homologous (having all characteristics in common). Despite the informal additions to Angle's system which orthodontist use, there is tendency to treat malocclusions of the same classification in a similar manner. Homologous malocclusion requires similar treatment plans, whereas analogous malocclusions may require different treatment approaches. Some poor responses to treatment are undoubtedly related to this fault in diagnosis.

How Angle's classification withstood test of time:

In spite of the criticisms faced by Angle, It has withstood the test of time because of its brilliant simplicity and is so entrenched in the specialty that it would take a revolution to replace it. Numerous methods have been made to mechanically classify malocclusion which upto the present time failed. Being the oldest system of classification it is most popular and widely used for teaching purpose. Various other methods have emerged to overcome the ambiguities of Angle's classification, but they failed to gain popularity because of its complexity, while Angle's system of classification is most practical and easy to comprehend.

Other systems of classification:

British Incisor Classification System vs. Angle's classification

British incisor classification (1983) is simpler and more relevant than Angle's classification. It is becoming increasingly used clinically now days in cases where molar classification cannot be applied like missing molars, mixed and deciduous dentition. Also since Angle's and British incisor classification is based on the antero-posterior relation of the upper and lower arch, it is used analogously in various epidemiological studies.

Rinchuse et al[52] (1998)found that British incisor classification was more reliable than Angle's classification. Reasons why the British System fared better than Angle was that, the British System had only five categories, whereas Angle's had seven. Therefore there is a "mathematical-statistical" advantage toward the British on reliability comparisons. Further, it does seem that the British system is far less confusing than Angle in regard to operational definitions of each of the categories. Angle was vague not only in his description of his "classes", but also unclear about what priority should be given for using the maxillary first molars as reference teeth. Hence, there is "latitude" in applying Angle's classification.

Though we the orthodontist may be particular in attaining ideal class I molar relation, patients are generally more aware of incisor rather than buccal segment relationship: thus its correction is a central concern of much orthodontic treatment. Modern orthodontists are more concerned with the proper position of the incisors relative to the profile for aesthetic and stability concerns and are willing to adjust first molar position and even sacrifice teeth to better align the incisors (concepts, Angle would never have accepted). Modern orthodontists advance molars in extraction treatments or distalize molars in nonextraction treatments with little concern for the immutable relationship of the upper first molar to the bony landmarks, such as the key ridge, as promulgated by Angle.

With the soft tissue paradigm embracing the contemporary orthodontics there is a shift in emphasis from molars to incisors. The concept of treatment planning today is based on ideal incisor position rather than an ideal molar relation.

Since classification should help in treatment planning also, we should also consider a classification based on anteriors.

Though Angle's classification faced lots of criticism Angle's system can certainly not be replaced, and it is arrogant and naive to assume it could be replaced or even modified in a major way that would be accepted universally. But we needed a substitute for Angle's classification in situations where it is not possible (missing molars) and we should consider an additional classification system based on anteriors when aesthetic needs are more demanding. These factors call in for the British incisor classification. Though there are few studies comparing the reliability of British incisor and Angle's, there is no previous study done to find the association between these two classifications.

Relationship between Angle's and British Incisor classification:

This study aimed to analyse the relationship between the two classification systems. There exist a statistically significant association between Angle's system of classification and British incisor classification seen as a whole .There was statistically significant association found between the British and angle's class I & class III. Though there were very few cases (4 in British class I and 3 in British class III) which differed.

No significant association found between British class II div I and Angle's classII div I. 29 out of 72 cases of British class II div I came under Angle's class I. There can be several possible reasons for this. Class II incisor relation in these cases may be due to any environmental influences like habits, therefore though the molars may be in class I relation, incisors showed class II div I relation.

Another possible reason could be due to Bolton's tooth size discrepancy with maxillary excess in the anterior ratio. In these cases to accommodate the arch length discrepancy, incisors take a place in the arch of larger circle and procline, giving a class II incisor relation while the molar relation may not perturbed in these conditions giving class I molars. Five of the cases with class II div I incisal relation and class I molar relation had constricted upper arch in transverse dimension. There was no significant association found between British class II div II and Angle's class II div II. Class II div II incisor may be a result of hyper active upper lip.

Future venues:

Although an overall association between Angle's and British incisor classification was found, it is very difficult to establish a

definitive association between them. Since this is the first study attempting to find an association between these two classifications further studies has to be done with a large sample size. Atypical cast can be selected and results can be compared with those of this study. Other diagnostic aids like lateral cephalogram can be used for classification. Further skeletal relations can also be taken into account.

SUMMARY AND CONCLUSION

Angle's classification is certainly the oldest and universally used classification. But to keep in pace with soft tissue paradigm and to classify challenging malocclusions with missing molars, due consideration should be given to British Incisor classification. And we have analysed the association between the British Incisor classification and Angle's classification.

Two hundred study cast were randomly selected from the patient records at the department of orthodontics, Tamilnadu govt dental college and hospital Chennai. Samples were divided into 4 groups based on British standard institute incisor classification –class I, class II div I, class II div II, and class III groups. The models were again classified based on Angle's classification.

The results were tabulated and association between British standard Incisor classification and Angle's were analysed using Chi-square test.

Overall Association between British Incisor classification and Angle's classification was found to be statistically significant. Statistically significant association was also found to exist between British Incisor & Angle's classification in class I and class III groups. But there is no statistically significant association in class II div I and class II div II groups between the two classification systems. Environmental influences like habits, aberrant muscular activity, and tooth size discrepancy may play a possible role for the non-association in class II cases between British Incisor classification and Angles classification

It is emphasised that both these classification should complement each other in describing malocclusion and they should not be regarded more than this.

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